

secondary schools, or to the discretion of the teachers of the elementary schools, elicited some difference of opinion; but on the whole the Conference favoured the plan of examination by a board appointed by the County Council, acting as far as possible in co-operation with the head masters of the secondary schools of the county. On one point all were agreed: viz. that there should be two examinations, or at least two standards—one for the country districts and the other for the towns—lest the whole of the scholarships should be monopolized by the most favoured districts. The opinion was also expressed that it might be sometimes desirable (as apparently would not be illegal under the Technical Instruction (Amendment) Act, 1891) to make scholarships tenable at certain efficient private profit schools, where no public schools are available, although such schools are debarred from receiving direct assistance. Such a course, however, would have to be adopted with the utmost caution.

Finally, the Conference considered the relations of the County Councils to the Technical Association, and a unanimous opinion was expressed in favour of a closer connection, while a suggestion was thrown out for the establishment of a quarterly journal registering the progress made in the various counties, a proposal which we are glad to hear is receiving the careful consideration of the Association.

Altogether, the discussion was felt to be of considerable value to those who have the practical work of organization in hand. We hope that such a Conference will be held annually, even if not more often, for in the novel work which lies before the County Councils points of difficulty will continually occur, on which consultation will be most useful. By the way, why should not the organizing secretaries form a permanent Association, on the model of the two Associations of Head Masters?

THE EVOLUTION OF ANIMALS.

L'Évolution des Formes Animales, avant l'Apparition de l'Homme. By F. Priem. 384 pages. Illustrated. (Paris: Baillière et Fils, 1891.)

IN this addition to the series of volumes known as the "Bibliothèque Scientifique Contemporaine," we have a worthy companion to Prof. Gaudry's "Les Ancêtres de Nos Animaux," published three years ago. To some extent, indeed, the ground is covered by M. Gaudry's more ambitious "Les Enchaînements du Monde Animal," but since the latter is in three volumes, the present work ought to find numerous readers who might be repelled by the length of the other. Moreover, the work before us has the advantage of treating each group of animals throughout geological time in consecutive form, whereas in the "Enchaînements" the Palæozoic Invertebrates are described in one volume, and those of the Secondary period in another, while the Tertiary forms are not recorded at all. Again, our author enters much more fully into the probable origin of one group from another than is the case in Gaudry's work. It is true, indeed, that in most cases these views are not original; but since they are generally taken from the highest authorities on the several groups, they will commend themselves the more strongly to students. In most works on palæontology

too little attention is, in our opinion, generally given to the evolution of the various groups of the Invertebrata from one another, and we can, therefore, give a hearty welcome to a volume like the present which is mainly devoted to this fascinating subject.

We need hardly say that Prof. Priem is an out-and-out evolutionist; and we trust that we shall not disparage his work by observing that in some cases—apparently carried away by the very natural desire to make the most of his subject—he appears to have gone rather too far, stating as facts what are at best but probable hypotheses. For instance, we find it definitely stated on p. 273 that the Stegocephalous (Labyrinthodont) Amphibians had a functional parietal eye, whereas there is, of course, no actual proof that this was the case.

The work is rendered attractive by the large number of woodcuts with which it is illustrated. We regret, however, that in some cases—and more especially among the Vertebrates—the execution of these figures is by no means satisfactory. Moreover, in the chapters devoted to the Vertebrates (some of which are the weakest portions of the work) there are figures which are not only bad, but are utterly untrue to nature. Thus on p. 266 the old figure of *Coccosteus*, with the maxillary bone doing duty for the mandible, once more reappears; while on p. 301 we have the reproduction of Goldfuss's erroneous restoration of *Pterodactylus crassirostris*, which is unfortunately given as an illustration of the short-tailed genus *Pterodactylus*, whereas that particular species belongs to the long-tailed genus *Scaphognathus*.

We notice that in many instances M. Priem gives his authority for his statements as to the phylogeny of particular groups, whereas in other cases such references are omitted. This is to be regretted, since it is often somewhat difficult to find out whether the author is promulgating his own views, or quoting those of others.

The volume commences with an introductory chapter on palæontological evolution, in which the phylogeny of the horse, and the well-known passage of *Paludina neumayri* into *P. harnesi* are instanced as the best examples we have of the derivation of one form from another. Following this chapter, we have the various groups of animals treated in detail, commencing from the lowest. In the main the classification adopted is fairly well up to date, although we shall note some instances where the author departs from the more usual modern arrangements.

For example, in treating of the classification of the Sponges on p. 36, the author disregards Prof. Sollas's separation of the Calcareous Sponges (Calcispongiæ) as a group of equal value with all the others (Plethospongiæ), so that we find the Soft, Horny, Flinty, and Calcareous Sponges ranked as equivalent groups. Again, in the Cœlenterates (or, as we prefer to call them, Zoophytes), the Palæozoic Corals are still classed under the primary divisions of Tabulata and Rugosa; the former group including such different forms as *Favosites* (belonging to the Zoantharia) and *Heliolites*, *Halysites* and *Chætetes* (usually referred to the Alcyonaria). Later on, however, pp. 62–64, the author recognizes *Heliolites* and its allies as the ancestors of the modern coral-like Alcyonarians, such as the Organ-pipe Coral (*Tubipora*), and we there-

fore fail to see his reasons for adopting the antiquated classification.

Some of the most interesting chapters in the volume are those devoted to the evolution of the Echinoderms, the author adopting Neumayr's view that the Palæozoic Blastoids, as well as Crinoids, Sea-Urchins, and Star-fishes, are all separate branches springing from the Cystoids of the Palæozoic. The figures illustrating the gradual specialization of the Sea-urchins from the old Palæoechinoids, with their numerous rows of interambulacral plates, through the Triassic *Tiarechinus*, and thence to the Neocomian *Tetracidaris*, with its two rows of apical interambulacrals splitting into four near its equator, and thence to the modern "regular" Urchins, strike us as particularly well selected. Equally instructive is the transition from the "regular" modern Urchins (Neoechinoids) to the "irregular" forms—at first with the retention of the masticating apparatus, and subsequently with its loss.

Merely noticing that full justice is done to Neumayr's views regarding the phylogeny of the Brachiopods, we pass to the Mollusca, which we find treated in considerable detail and well illustrated. The author adopts the modern view of separating *Dentalium* as a distinct order (Scaphopods) from the Gastropods, and considers that both Pelecypods (Bivalves) and Scaphopods are derived from the latter. Nothing is said as to the origin of the Gastropods themselves, or, indeed, of the Cephalopods—probably for the very sufficient reason that nothing definite is yet known. In regard to the mutual relations of the various groups of Cephalopods, the author comes to the conclusion that the Ammonites should form a distinct order, "Ammonoidea," to be placed between the Tetrabranchiates (*Nautilus*) and Dibranchiates (Cuttlefish). Since, however, he adopts the view that their shells were really external, and that they are probably descended from Nautiloids, there seems but little necessity for this third order. The gradual increasing complexity in the sutures as we pass from Goniatites to Ceratites, and from the latter to true Ammonites, is held sufficient to prove the descent of the latter from the former; while Goniatites are considered to be the direct offshoots from Nautiloids, which are themselves derived from straight forms like *Orthoceras*. It would require too much space to enter on the consideration of the relations of the various genera of Ammonites to one another; but we may mention that the author fully adopts the modern views, such as the evolution of the keeled *Amaltheus* of the Jurassic from *Ptychites* of the Trias, and also that the uncoiled forms (*Hamites*, *Scaphites*, &c.) have had several distinct points of origin from true Ammonites. And here we may take the opportunity of mentioning that the terms *Ægoceras* and *Haploceras* applied to genera of Ammonites, are preoccupied by two well-known genera of Mammals, and therefore require changing. In regard to the Dibranchiate Cephalopods, it is considered that Belemnites have been derived from forms allied to Goniatites, and have themselves given origin to the modern Cuttle-fish. If this be the true phylogeny of the Cephalopods, it indicates a gradual increase in the complexity of the shell of the Tetrabranchiates, till it attained its maximum in the Jurassic and Cretaceous. Then the total disappearance

of all the external-shelled forms with the exception of the *Nautilus*; while at the same time the Dibranchiates were gradually tending to develop less and less complex internal shells, till these culminated in the simple "pens" and "bones" of the modern cuttles and squids.

Coming to that portion of the work devoted to the Vertebrates, we find, as already mentioned, that the author has been in some places less successful than in the earlier chapters. We have already alluded to the misleading nature of one of the figures in the chapter on fishes, and we have to add that several of the few others with which that chapter is illustrated are highly unsatisfactory. It is probable, indeed, that the author had no opportunity of seeing the second volume of the "British Museum Catalogue of Fossil Fishes" before passing his proofs, as otherwise he would doubtless have modified some of his statements.

In his remarks on the difficulty of distinguishing between Dipnoid and Ganoid fishes (p. 265), the author seems to be totally unaware of the difference between the "autostylic" skulls of the former and the "hyostylic" of the latter; and when, on p. 267, he states that the Dipnoids are a lateral branch of the Crossopterygian Ganoids, he is directly at issue with the writer of the Museum Catalogue, who states (p. xx.) that, "concerning the evolution of the Dipnoi, palæontology as yet affords no information." Again, although Prof. Cope's observations as to the primitive structure of *Pteraspis* and its allies are referred to, we doubt whether the suggestion that the opening on the dorsal side of the head-shield corresponds to the aperture of a parietal eye will commend itself to the students of ichthyology. The chapter on the Batrachians is all too short; and, bearing in mind their resemblance to the Dipnoids in the autostylic structure of the skull, it is scarcely safe to make the statement (p. 282) that they are derived directly from Ganoids.

From his treatment of reptiles we fear that the author has but a very faint conception of the nature of a Theriodont or a Dicynodont, or else he would surely have made more of their affinity to the Batrachians on the one hand, and to Mammals on the other; while he would have also omitted any reference to the purely adaptive resemblance existing between the skull of *Udenodon* and that of a turtle. M. Priem might also have informed his readers that Dicynodonts are not confined to Africa. On the other hand, we are pleased to see that M. Priem rejects the heresy propounded by some of his countrymen, that Ichthyosaurs were derived primitively from marine reptiles, in favour of the more rational view of their near relationship to the Rhynchocephalians. In stating that the Plesiosaurs are likewise related to the Rhynchocephalians, the author is in accord with modern views, although he should also have referred to the many indications of affinity presented by these reptiles to the Chelonians. When, however, it is stated, on pp. 295, 296, that the latter were probably derived from the toothless Dicynodonts (*Udenodon*), the author at once proclaims his ignorance of some of the leading features of reptilian osteology. The statement on p. 297, that the gigantic Sivalik tortoise had a shell measuring four metres in length, leads us to wonder when this fiction will finally disappear from text-books. The author's treatment of

the Pterodactyles and Dinosaurs calls for no separate mention, although we are led to wonder why the Crocodiles are so widely separated from these groups.

The whole chapter on birds is decidedly feeble; and we must certainly take exception to the statement that *Hesperornis* and *Ichthyornis* respectively connect *Archæopteryx* with the Ratitæ and Carinatae.

Turning to the last chapters, on the Mammals, we find the author adopting the view that the Monotremes have had an origin totally separate from the other two subclasses. We then have a notice of the Secondary Mammals, in which we observe a lamentable lack of attention to recent work on their affinities, and also to the synonymy of the various genera. We also notice that the Jurassic *Plagiaulax* and its allies are still referred to the Diprotodont Marsupials (p. 327); so that on these points the author's evolutionary views are totally out of date. Following the Marsupials, we have a very fair, although brief, account of the most recent conclusions on Mammalian phylogeny, which needs but few remarks. We notice, however, that the author adopts M. Boule's views as to the dual origin of the *Canidae*, according to which the Foxes (Alopecoids) are considered to have originated from *Cynodictis*, while the Wolves, Jackals, and Dogs (Thooids) trace their descent to *Amphicyon*. To ourselves, indeed, it has always appeared difficult to understand how these two groups of *Canidae* have become so much alike if they had this dual origin; and this difficulty is increased by the author's statement that those Thooids known as *Cyon* differ from the other members of that group in having originated from *Cynodictis*.

On p. 343 the author makes a slip in stating that the Hydracoidea are now represented only by a single genus; while later on he appears to be uncertain whether the Siwalik beds should be regarded as Upper Miocene (pp. 349, 350) or Upper Pliocene (p. 366). Again, we notice on p. 353 some want of acquaintance with the recent literature relating to the ancestry of the horse, *Orohippus* being identified with *Pliolophus*, whereas the latter is really the same as *Hyracotherium*, while the former is identical with *Pachynolophus*. We are in full accord with the author when he states, on p. 361, that *Chalicotherium* (with which the supposed Edentate *Macrotherium* is now known to be identical) is an aberrant Ungulate, although we must be permitted to differ from him when he adds that it shows signs of affinity with the Edentates.

We must likewise take exception to the statement, on p. 370, that the Indian Nilgai is in any sense the progenitor of the Oxen; while the view expressed on the same page, that the Buffaloes, Bisons, and true Oxen have severally originated from three distinct groups of Antelopes, can be only regarded as another instance of the author's partiality for multiple phylogenies. Although M. Priem is careful not to commit himself to the view that the Cetaceans have been derived from the extinct Enaliosaurian reptiles, yet the prominence which he gives to the statement of that view may be taken as a sign that he has not thoroughly purged himself from that heresy.

Finally, although we have felt bound to call attention to a certain amount of imperfection in the later chapters, yet, as a whole, we can conscientiously recommend the

work before us to those readers who are desirous of obtaining in a compact form a summary of the evidence afforded by palæontology of the progressive evolution of animal forms.

R. LYDEKKER.

METALLURGY.

Leçons sur les Métaux. Par Prof. Alfred Ditte. (Paris: Dunod, 1891.)

Traité pratique de Chimie Métallurgique. Par le Baron Hans Jüptner von Jonstorff. Translated from the German by M. Ernest Vlasto. (Paris: Gauthier-Villars, 1891.)

THESE two volumes, recently published, are both of unusual interest. The first, by Prof. Ditte, who is well known to English readers by his "Exposé de quelques Propriétés générales des Corps," may be said to mark a new departure in teaching the chemistry of metals. He points out that the principles of thermochemistry do not merely enable reactions to be explained, but to be predicted, and, on the other hand, when two sets of reactions are simultaneously possible, the laws of dissociation render it possible to rigorously define the conditions of equilibrium which are established in the chemical "systems" under consideration. It is often possible, with the guidance afforded by these laws, to say, in the absence of direct experiment, why one reaction is impossible and another certain to occur; or why a certain reaction begins without difficulty, and is arrested at a definite stage; or why a reaction which takes place readily under certain conditions cannot be effected under others that do not appear to differ greatly from those which were favourable to it. As a pupil of Deville, the author might have been expected to develop, in a treatise such as this, the teaching of his great master, and he has admirably performed his task. The classification of the work is excellent, the metals being first considered collectively, and then in detail with numerous tables of the data and constants which are so frequently required by metallurgists.

The work begins with a very clear account of Berthelot's labours in *mécanique chimique*, special care being devoted to the description of the calorimetric investigations, and to the appliances adopted in these important researches.

It appears to be a great advance for us in this country to read a chemical treatise in which the thermal values of the equations are stated in calories, side by side with the formulæ. As the book is too long to review in detail, it may be well to indicate the nature of one section only, as showing the author's care and thoroughness in the selection and arrangement of the materials. Take, for instance, the few pages devoted to carbides. The author points out that carbon in uniting with metals sometimes gives rise to the formation of true compounds, and at others to solutions of carbon in the metal. He then describes the orange-yellow product obtained by the action of carbon on metallic copper, and passes to the association of carbon with nickel, which does not confer upon nickel the property of being hardened by rapid cooling. The definite carbides of manganese, as well as the indefinite associations of carbon with iron and manganese, receive due attention,